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ABSTRACT

A school district energy management program reduced oil consumption 34 percent and electrical consumption 20 percent. Low cost modifications to the heating and ventilating equipment in the schools resulted in energy savings that "paid back" the labor plus material costs in less than a year. Each building was placed into an energy conservation condition, requiring the personnel using the facility to perform an action to obtain the "occupied" environmental condition. (Author/MLF)

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A CASE STUDY

OF

COMPLETE ENERGY MANAGEMENT

AT THE

HERRICKS UNION FREE SCHOOL DISTRICT

BEST COPY AVAILABLE

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EA 008 776

During the Fall of 1973, when the Energy crisis officially arrived, the Herricks U.F.S.D. undertook a program for Energy Management with the Grumman Aerospace Corporation's Energy Conservation Systems Department. We are presently $2\frac{1}{2}$ years into a program which has approximately 2 years more to run and the track record to date indicates a 34.3% reduction in oil consumption and a 20.3% reduction in electrical consumption district wide (see Figure 1).

The program's approach is one of controlling energy use so that the building operation is largely independent of the operating personnel. One need only examine the energy used per square foot per year of floor area or surface area, for each building in a school district (see Table 1 below for Herricks), to recognize that, despite the same environment and approximately the same building use or occupancy, the disparity in energy use is large.

TABLE I - BEFORE ENERGY CONSERVATION PROGRAM

School Building	Gal/ft^2/yr.
1. Herricks H.S.	.913 (.91)*
2. Shelter Rock Jr. H.S.	.786 (.63)
3. Herricks Jr. H.S.	.74 (1.00)
4. Center St. Elem. School	.96 (.67)
5. Denton Ave. Elem. School	.997 (.7)
6. Searingtown Elem. School	1.13 (.77)
7. Wickshire Elem. School	1.07 (.73)

* No.'s in parenthesis are gal/ft^2/yr. where ft^2 is building surface area.

This is primarily attributable to the uneven way the heating and ventilating equipment is being used from building to building. To overcome this problem, we adopted a change in philosophy related to the way energy is used. Each building was placed into an energy conservation condition, requiring the personnel using the facility to perform an action to obtain the "occupied" environmental condition.

After an established period of time, the system automatically returns to the energy conservation condition.

To trace through the program from its inception, it is necessary to discuss the survey phase which provided the visibility for the conclusions indicated above. A thermal balance was performed for each building by analyzing the energy required during the previous year and matching it with the energy used as obtained from the prior year's actual oil deliveries. The occupancy, weather data, heat losses or gains through the walls and roof, light and sun load, motor loads, etc. were considered in the analysis. Since school buildings are occupied approximately 20% of the heating season, it was evident from the analysis that far too much energy was being used during the unoccupied condition. In fact, the Senior High School had approximately seven (7) times as much energy consumed during the unoccupied condition as was used while the facility was occupied. Furthermore, the way the facility was ventilated and heated during the occupied mode was wasteful. We then analyzed the savings potential when low cost modifications to the equipment were made. It was evident, from the analysis, that the labor plus material costs would be "Paid Back" in less than a year through resulting energy savings. The actual cost for labor and material to make the modifications was $45,718.80. This modified the entire district of 681,364 ft^2* (7 buildings). The district wide energy used for space heating was .87 gallons per sq. ft. per year prior to the modifications. This was reduced to .57 gal. per sq. ft. per year after the modifications, or a 34% reduction. Of great significance was the confidence that these savings could be obtained year after year independent of the personnel operating the equipment, since the only time "occupied levels" of energy consumption would be incurred was if an action was taken.

To accomplish these modifications, specifications and drawings were created, and the school district submitted them for bid. The installation was

* Floor area

supervised by Grumman. At the completion of the installation, a presentation was made to the faculty and custodial personnel for each building by a Grumman representative, after which, discussion ensued. The purpose of such a presentation is to permit a clear understanding of the environmental controls that are available to the faculty and custodial personnel, respectively.

At this point in time, we began cur energy management programs. This included data gathering that involved the schooi district custodia' personnel (see Fig. 2)

Figure 2

GRUMMAN ENERGY CONSERVATION — ENERGY CONSUMPTION LOG — HERRICKS PUBLIC SCHOOLS

SCHOOL Herricks Senior High — WEEK OF Sept 2nd

		MON 9/4	TUE 9/5	WED 9/6	THUR 9/7	FRI 9/8	SAT 9/9	SUN 9/10	TOTALS	REMARKS
FUEL OIL CONS. (GALLONS)		47	30	80	25	20	47	47	295	
ELAPSED TIME INDICATORS (HOURS)	1	400.8	368.1	377.1	345.7	393.5			32.7	
	2	287.5	355.2	364.1	372.7	380.5			32.6	
	3	329.8	376.8	365.8	394.5	382.4			33.0	
	4	411.8	379.2	383.1	396.7	404.5			32.6	
	5	392.1	359.4	363.8	377.0	384.7			31.7	
	6	449.7	416.5	425.4	434.1	442.0			33.2	
	7	655.3	615.8	639.0	636.3	645.8			29.5	
	8	771.1	740.6	756.5	759.0	767.6			32.5	
	9	464.1	433.1	443.2	456.0	458.8			31.0	
	10	422.9	419.8	420.9	424.9	424.9			3.1	
	11	507.3	491.6	493.0	496.8	501.9			15.6	
	12	392.1	359.8	369.5	377.0	384.7			32.2	
	13	329.8	363.4	356.1	364.7	372.4			33.6	
	14	210.4	210.3	210.3	210.3	210.3			0.1	
	15	743.5	712.0	720.7	719.4	727.9			36.4	
		TEMP. READING - 06:30 HRS. ELEC. OIL + CLOCKS 0900 HRS								
		ELEC. METER READING 2-3-0-5 X 360								

FUEL OIL AND ELAPSED TIME INDICATOR READINGS ARE TO BE MADE AT THE SAME TIME EACH DAY

The elapsed time indicator readings in Fig. 2 are the number of "day" cycle (occupied) hours spent each day for each zone in the building. This data enables the administrative staff to easily verify that the building's use, in so far as the heating and ventilating systems are concerned, is in accordance with the prior documentation (see Fig. 3) outlining the responsibilities of the respective building principals. Additionally, the daily oil consumption and

Figure 3

MEMO TO: PRINCIPAL OF EACH SCHOOL

FROM : H. E. PAIGE

DATE : August 26, 1974

USE OF CYCL-FLEX TIMERS AT THE HERRICKS SCHOOLS

1. Cycl-flex timers to be used on SCHOOL DAYS ONLY (Mon-Fri) from 6:30 AM for a period of five hours. Any zone requiring more time shall not exceed an additional three hours (until 2:30 PM).
2. Cycl-flex timers shall not be used at any other time except by direct authorization of the school principal. Such authorization shall be indicated in the remarks column of the Energy Usage Data Log to be filled out by the designated custodian.
3. Authorization by the principal of the school shall be limited strictly to a particular area in which the building is being utilized by student personnel, i.e., a student dance, a student basketball game, or a play involving students.
4. All authorization by school principal shall be given in writing at the time of authorization to the Superintendent of Buildings and the school head custodian.

weekly electric meter readings are recorded on the data log.

The objective of the energy management or monitoring phase is to obtain data that identifies the efficiency of energy utilization for each building. It was previously pointed out, via Table 1, that a symptom of needed energy conservation is the difference in gal/ft^2/yr. being consumed from school building to school building. An interesting example to support this is the many instances where identical schools (twins) in a district have substantially different consumption levels for the same month. For two identical elementary schools (a 4000 ft^2 addition was made to one of the schools - 52,147 ft^2 vs. 56,147 ft^2) the oil consumed during the month of Oct. '73 was 3911 gallons vs. 8604 gallons. This was before the modifications were installed. After the mod's, the oil consumed during the month of Oct. '74 was 2313 and 2293 gallons, respectively. Not only were they lower, but they were consistent, as might be expected when the energy consumed is largely independent of the personnel operating the facilities.

Figure 4 indicates the respective reductions in energy consumed for each of the buildings in the district subsequent to the modifications.

It would be inappropriate to conclude without some remarks related to the 20.3% savings achieved by a reduction in the electrical energy used. The program for electrical conservation had as its objectives a potential reduction in lighting levels and motor horsepower. The district undertook to achieve the light reduction program by a "Lights Out" program. The electrical consumption in a school district (assuming no air conditioning) is essentially responsive to lighting (80%) with approximately 20% attributable to the motor horsepower associated with the heating and ventilating supply and exhaust fans. The 20% figure was substantially impacted by the modifications to the heating and ventilating systems and is demonstrated by comparing three summer sessions, during which light usage was minimal (see Figure 5). The savings were achieved by the automatic

FIGURE 4

CHUBBIAN ENERGY MANAGEMENT PROGRAM
FOR
HERRICKS UNION FREE SCHOOL DISTRICT

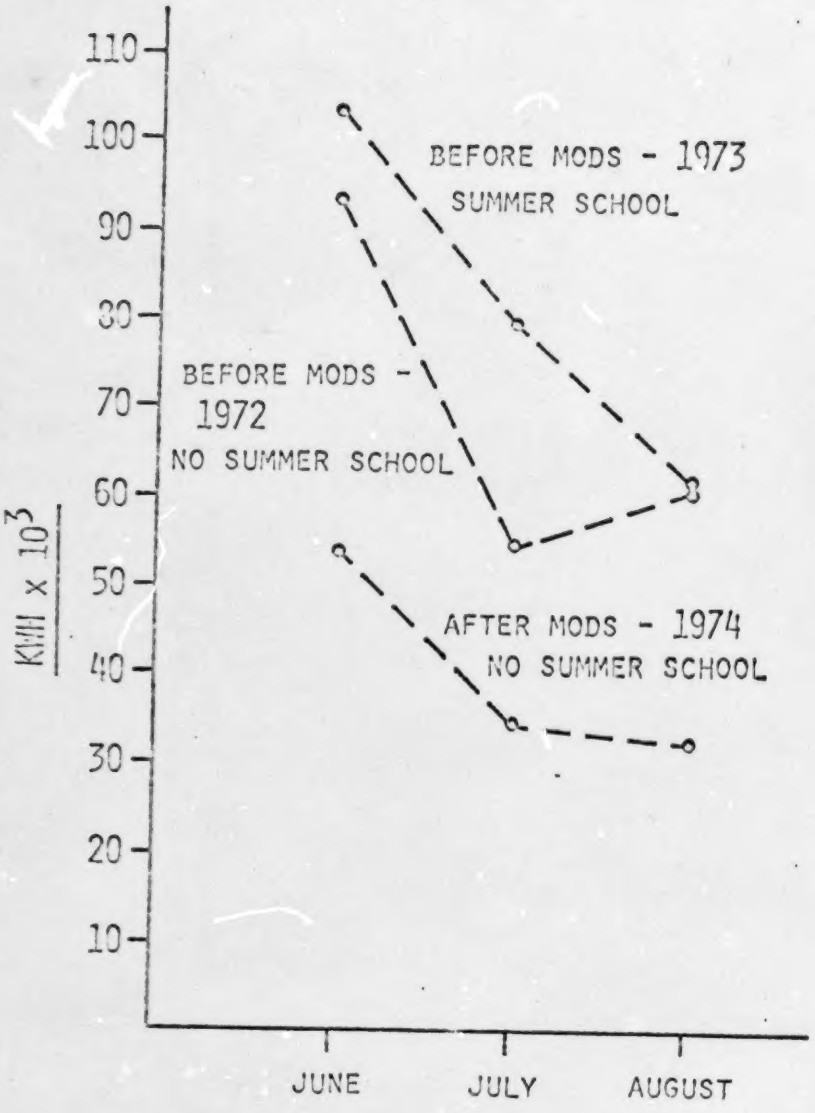
School	74/75 April	74/75 May	74/75 June	74/75 July	74/75 Aug.	74/75 Sept.	74/75 Oct.	74/75 Nov.	'74 Dec.	'75 Jan.	'75 Feb.	'75 Mar.	Annual Savings	Base* Year Consum.	% Saving
Fuel Oil Savings - Gallons															
Herricks SHS	5,305#	4,345	0	0	0	8,307	13,695	5,392	14,542	10,520	9,299	17,497	88,862	202,897	43.8%
Center St. Elem.	1,680	419	-174	0	0#	359	1,598	960	1,799	1,430	1,941	2,447	12,459	49,602	25.1%
Denton Ave. Elem.	1,243	- 70	-217	-13	0#	1,588	6,311	781	916	3,593	2,046	3,414	19,592	57,651	34.0%
Shelter Rock JHS	3,047	- 740	-384	0	0	3,971#	8,836	2,919	7,274	4,201	2,118	6,872	38,174	92,918	41.1%
Searingtown Elem.	3,187	- 449	-378	0	0	25	2,767	415	2,408#	2,912	1,497	2,949	15,333	60,054	25.4%
** Wickshire Elem.	931	107	-867	0	0	--	--	--	813#	1,597	1,428	2,737	6,746	37,244	18.1%
Herricks JHS	1,250	739	-689	-175	-225	1,444	1,519	-141	3,320#	6,817	2,034	5,944	21,833	91,235	22.4%
Monthly Total	16,643	4,341	-2709	-188	-225	15,694	34,746	10,326	31,078	31,070	20,363	41,860	202,999	591,001	34.3%
Cumulative Total	141,014	145,355	142,646	142,458	142,233	157,927	192,673	202,999	31,078	62,148	82,511	124,371			
Electrical Savings - KWH															
Herricks SHS	28,271	32,414	49,274	45,046	28,904	52,653	26,613	45,699	38,470	36,727	21,741	46,197	452,009	1,493,280	30.3%
Center St. Elem.	-9,210	-4,679	-815	-2,027	862	1,075	- 1,192	- 1,677	2,713	78	- 297	1,553	-13,616	215,408	-6.3%
Denton Ave. Elem.	3,222	4,026	3,252	1,870	1,865	- 774	- 805	- 107	5,482	86	2,670	- 58	20,729	222,947	9.3%
Shelter Rock JHS	-3,473	3,936	14,276	5,226	10,017	- 2,222	- 365	16,838	26,217	- 7,392	5,537	12,641	81,346	637,683	12.8%
Searingtown Elem.	1,662	2,294	5,249	3,959	3,105	-15,818	2,582	18,585	2,404	1,190	1,660	592	27,374	264,420	10.4%
Wickshire Elem.	1,037	2,473	(No Reading)	(School	Shutdown)	--	--	--	5,345	7,698	6,369	8,002	30,924	150,766	20.5%
Herricks JHS	2,470	11,726	5,157	3,981	7,147	1,769	10,017	6,370	13,070	8,002	2,875	19,147	91,731	419,819	21.9%
Monthly Total	23,979	52,240	76,393(1)	58,055(1)	51,900(1)	36,683	36,850	85,708	93,761	46,389	40,555	87,984	690,497	3,404,223	20.3%
Cumulative Total	292,668	344,908	421,301(1)	479,356(1)	531,256(1)	567,939	604,789	690,497	93,761	140,150	180,705	268,689			

*Degree Day Adjusted - Oil Only

#Indicates Start Date in 1974

(1) Excluding Wickshire - No Reading

**Wickshire closed as of 9/1/75 - Savings based on 9 month period



	'72	'73	'74
JUNE	93240	103274	54000
JULY	54720	79246	34200
AUGUST	60480	61304	32400

Figure 5

shut-down of essentially all motor horsepower. This automatic shut-down is integrated into the modifications so that it too requires a positive action to obtain motor power. Similarly, when that action is taken, it is timed to go off automatically.

It is apparent from the data and information presented that substantial reduction in energy consumption, in the form of fuel oil and electrical power, can be accomplished with minimal capital investment.

Further, the system, as described, is to a high degree free from dependence on operating personnel to insure its proper functioning. The requirement of logging certain data provides appropriate management personnel ready reference to meaningful information for energy management.

To conclude, the energy management system installed in no way sacrifices comfort levels to those occupying the building. It is safe to say that such a system has application not only to school buildings but to a wide variety of structures requiring heat and electrical power.